Risk assessment in the recovery of food for social solidarity purposes: preliminary data

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Abstract

The most recent study, conducted by Politecnico of Milan, on food surplus management in Italy shows that in the Italian food supply chain the food surplus is around 5.5 million tons/year, and the amount of food wasted is around 5.1 million tons/year. During 2015, the charitable organizations (COs) belonging to the Italian Food Bank Network, active in recovering and distributing food for social solidarity's purposes, reused 381,345 tons of food from 2292 donors. The main supplying sources of the *Banco Alimentare* Network are: food industries, organized large-scale retail trade and collective catering service. The aim of this study was to analyze several aspects of the food surplus recovery thanks to the collaboration with the *Banco Alimentare* Foundation Onlus and *Caritas Italiana*. In particular, two main features were analyzed in the food recovery chain: the microbiological profiles of specific food categories recovered from catering service with the aim to evaluate their conformity in relation to food safety and process criteria. For this purpose 11 samples were analyzed in four different moments: T0, same day of the collection; T1, after four hours of storage at 4°C; T2, 24 hours from the collection (storage at 4°C); T3, after four days at frozen storage (-18°C). For all samples several microbiological parameters were investigated: enumeration of mesophilic aerobic bacteria (AFNOR 3M 01/1-09/89), enumeration of *Enterobacteriaceae* (AFNOR 3M 01/06-09/97), enumeration of *E. coli* (AFNOR 3M 01/08-06/01), enumeration of coagulase-positive *Staphylococci* AFNOR 3M 01/9-04/03 A), enumeration of *Bacillus cereus* (UNI EN ISO 7932:2005), research of *Salmonella* spp. [UNI EN ISO 6579 (2008b)], and research of *Listeria monocytogenes* [AFNOR BRD 07/4-09/98 (AFNOR, 2010a)]. Furthermore, the volunteer's knowledge on the correct hygienic procedures during the recovery was evaluated by the 71 questionnaires with the aim to prevent foodborne diseases. The results show that the recovery of surplus from catering service and their reuse at COs should be planned with correct procedures, and the volunteer's knowledge on the hygienic aspects appears to be a critical point. The recovery and the charitable activities require an appropriate assessment and careful risk analysis, in order to manage the complexity of no profit organization.

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Introduction

Food and Agriculture Organization (FAO) estimates that each year one third of all food produced for human consumption in the world is lost or wasted and this represents a missed opportunity to improve global food security (FAO, 2013). For this reason, the food surplus recovery for solidarity purposes is an immediate instrument to respond to the problem of food poverty at a national and international level. The latest data from the Organization for Economic Co-operation and Development (OECD) show that the food poverty is paradoxically related to the food waste and surplus (OECD, 2013). The amount of food wasted each year in Italy is around 5.1 million tons, 53% of which is generated by economic players in the sector, the 47% in households and only 500,000 tons are recovered (9% of food surplus) (Garrone *et al.*, 2015). The *paradox of lack in abundance* and the phenomena of surplus and food waste would be ethically indefensible if had not been created the possibility to transform this contradiction in a positive opportunity: the creation of Food Banks.

Food Banks are no profit charitable organizations that are active in recovering and distributing food to people in need. This activity is possible thanks to the volunteer's work and donors of large amount of surplus. The first Food Bank (St. Mary's) was founded in Phoenix (AZ, USA) in 1967 by John van Hengel. In Europe the first Food Bank was created in Brussels, subsequently the requirement to speak with one voice to European institutions and international companies became necessary, hence the creation of the European Federation of Food Banks (FEBA's) in 1986. The most important Food Banks in Italy are represented by *Caritas Italiana* and *Banco Alimentare* Foundation Onlus (FBAO). *Caritas Italiana* is a pastoral organization of the Italian Bishop's Conference, it connects with 220 diocesan *Caritas*, committed with their daily activities to support the neediest people in food poverty. *Banco Alimentare* Foundation Onlus (FBAO) was founded in Milan in 1989, and obtained the Onlus qualification in 1999. The foundation coordinates a network of 22 organizations spread all over the country.

FBAO serves 8898 charitable institutes assisting people in need, while *Caritas Italiana* has 2832 Caritas centers (Rovati and Pesenti, 2015). Together they recover nearly 70% of all food assistance provided in Italy.

FEBA, between 1988 and 1992, supported the development of Food Banks in Spain, Italy, Ireland, then followed by Portugal, Poland, Greece and Luxembourg from 1994 to 2001. Since 2004, Hungary, the Czech Republic, Slovakia, the United Kingdom, Lithuania and Serbia have joined the network, followed in 2010 and 2011 by the Netherlands, Switzerland, Estonia and Denmark, in 2013 by Bulgaria and Ukraine and by Norway in 2014.

The mission of *Banco Alimentare* Network is to recover the food surplus, still perfectly edible, from food industry and organized large-scale retail trade and to distribute it to the charitable organizations. Several years ago the *Siticibo* project was born. Thanks to this project, *Banco Alimentare* can recover not exposed food by organized catering and mass distribution at the end of the public and private events. The *Banco Alimentare* Network's activity is possible thanks to the work of over 17,000 volunteers. The activities conducted by the no profit organizations are permitted and protected from specific law, such as the Law 155/2003 known *Good Samaritan Act* (Italian Republic, 2003; European Economic and Social Committee, 2014). This law enshrines that non-profit recognized organizations that work for solidarity purposes in accordance with Article 10 of the Legislative Decree of 4th December 1997, n. 460, ff. as amended, and which freely distribute foodstuff to indigents for charitable purposes, are equalized to final consumers. This law, in conformity to Article 21 of Regulation (EC) n. 178/2002 (European

Commission, 2002) and civil liability laws previously referred, exceptionally states that the donor is free of possible legal actions arising from given products.

The no-profit organizations manage food under the respect of the European food safety regulation, in this specific case the European food safety legislation provides the application of simplified procedures considering the level of complexity of each charitable organization (CO) and permits the elaboration of Good Hygiene Practices Manuals according to Regulation (EC) n. 852/2004. In fact, the COs are considered a special category of food business operators, which differ from for-profit businesses in their charitable system of collection and distribution as they follow the most important items: the free nature of their activity distinguishes their social scope, the great variety of foods handled, high number and turnover of volunteers with different educational backgrounds, food donated to people in need, the great variety of donors, and the lack of scientific studies about the second life of foodstuff for charitable purposes.

The following items were investigated: i) the knowledge on food safety of volunteers involved in recovery activities; and ii) the hygienic status of food recovery from private catering at the end of the event, in order to determine, in four following moments (second life) and under several different preservations terms, the right way for charitable organizations to prevent foodborne disease outbreaks in people in need. One hundred questionnaires were distributed to volunteers of 2 COs, distributed throughout Italian territory, and only 71 questionnaires were collected in a complete and anonymous form.

Materials and Methods

Sample collection

The samples collected at the end of a private catering were transported to the Laboratory of Food Inspection in a refrigerated termobox at 4°C (±2), and were analyzed in 4 different moments: i) (T0) same day of the collection; ii) (T1) after four hours of storage at 4°C; iii) (T2) 24 hours from the collection [storage at 4°C (±2)]; and iv) (T3) after four days at frozen storage (-18°C). Each food sample (approximately 1 kg) was divided into 4 aliquots. The samples were divided into 2 categories according to Ce.I.R.S.A guidelines (*Centro Interdipartimentale di Ricerca e Documentazione sulla Sicurezza Alimentare*/Interdepartmental Research and Documentation Centre of Food Safety; http://www.ceirsa.org/pubblicazioni.php).

Category A: multi-ingredients preparation cooked ready-to-eat samples

Specifically, the samples collected were: n°1 (*lasagna*), n°2 (strudel with ham and cheese), n°3 (*ravioli* like with meat), n°4 (potato dumplings), and n°5 (omelette with vegetables).

Category B: multi-ingredients preparation ready-to-eat to be eaten uncooked or some raw ingredients samples

Specifically, the samples collected were: n°6 (rice salad), n°7 (wheat salad), n°8 (Greek salad), n°9 (roast beef), n°10 (cous cous with vegetables), and n°11 (lemon mousse). The food samples were preserved (up to 4 hours) in closed gastronorm and the storage temperature were: category A at ≥+60°C and category B at ≤10°C. The food samples were not exposed at room temperature during the event.

Microbiological analyses

The microbiological analyses focused on pathogenic, potential pathogenic microorganism and hygienic markers. In particular, enumeration of mesophilic aerobic bacteria, enumeration of *Enterobacteriaceae*, enumeration of coagulase-positive *Staphylococci* (CPS), enumeration of *Bacillus cereus*, enumeration of *Escherichia coli*, and the research of *Salmonella* spp. and *Listeria monocytogenes* were investigated.

For the food samples, an analytical unit (10 g) was aseptically taken from each unit, added to 90 mL of sterile diluent solution (0.85% NaCl and 0.1% peptone), and homogenized in a stomacher (Star Blender Digital-EUplug 710-0958) for 1 min at room temperature and then serial 10-fold dilutions were prepared in a sterile saline solution. Mesophilic aerobic plate counts (APC) and *Enterobacteriaceae* plate counts were enumerated using a Petrifilm Aerobic Count (3M, St. Paul, MN, USA), following the: AFNOR 3M 01/1-09/89 and AFNOR 3M 01/06-09/97 respectively. Petrifilm plates were also used to determine *E. coli* (EC), and CPS, in accordance with the following methods: AFNOR 3M 01/08-06/01 and AFNOR 3M 01/ 9-04/03 A, respectively. *A bacillus cereus* count was enumerated according to: UNI EN ISO 7932:2005 (ISO, 2005). *Salmonella* spp. detection (analytical unit: 25 g) was carried out using UNI EN ISO 6579:2008 (ISO, 2008) and the presence was confirmed by an API 20E system (Biomérieux, Marcy l'Etoile, France). The detection of *L. monocytogenes* (analytical unit: 25 g) was performed according to AFNOR BRD 07/4-09/98 (AFNOR, 2010a) and the presence was confirmed according to the AOAC N.060402 (MID 67), 2010 method (Balzaretti *et al.*, 2009).

Questionnaire formulation

The aim of the questionnaire was to investigate the volunteer's knowledge about good hygiene practices in food recovery supply chain. The questionnaire was divided in 2 sections: the first one related to characteristics of survey respondents, the second one composed of 10 questions. The first section was about personal information: age, sex, educational qualification, the role in the COs organizational chart and their own interest on hygienic aspects related to recovery activities. The second one was about the knowledge on hygienic prerequisites, food borne diseases, labeling, traceability, and good manufacturing practices (GMPs) to evaluate the volunteer's knowledge were formulated the questions described in

Table 1. Survey questions.

Topics	Questions
Knowledge on hygienic prerequisites	1. What are the basic steps for washing hands? 2. What are the correct hygienic procedures for handling of food?
Knowledge on food borne diseases	3. What is a food borne illness? 4. What are pathogenic that can cause foodborne diseases? 5. What food has a greater contamination risk with Salmonella species?
Knowledge on labeling	6. What is the meaning of *best before*? 7. What is the meaning of *expiry date*?
Knowledge on traceability	8. What are the correct procedures of food registration in incoming and outgoing?
Knowledge on GMPs	9. What are the correct storage temperatures of perishable food? 10. What is the correct sequence of the sanitisation procedures?

GMPs, good manufacturing practices.

Table 1. The questionnaires were distributed to all the volunteers, who carry out their activities permanently, at the two different COs (groups 1 and 2). A total of 100 questionnaires were distributed. In particular: group 1 received 70 questionnaires and group 2 received 30 questionnaires. At the end of the survey questionnaires were returned compiled: 50 and 21 questionnaires for groups 1 and 2, respectively. Furthermore, all the volunteers, who completed the questionnaires, had not followed a specific training about good recovery practices. All the questionnaires data were performed using SPSS (SPSS/PC Statistics 18.0 SPSS Inc., Chicago, IL, USA). Data are presented as percentage of correct reply.

Results

Microbiological results

In Table 2 the critical limits of categories A and B and their evaluation standard (Ce.I.R.S.A guidelines) are presented. The microbiological results are given in Table 3, and the data for both categories are expressed in relation to the evaluation in four different moments (T0, T1, T2, T3), and for each investigated parameters. Two food samples (n°7: wheat salad and n°9: roast beef) belonging to category B (multi-ingredient preparation ready-to-eat uncooked or some raw ingredients samples) showed the presence of *Listeria monocytogenes* and *Salmonella* spp. respectively in T0, T1 and T2. At T4, after freezing for four days, both the food samples were in compliance. The food sample n°10 (cous cous with vegetables) shows that an unsatisfying situation for *Bacillus cereus* and *Enterobacteriaceae* parameters, at T0, T1, T2, T3 and at T0, T1 and T2, respectively. For the remaining samples of the category B, the data showed a compliant situation at T0, T1, T2 and T3, and all food samples belonging to the category A (multi-ingredient preparation cooked ready-to-eat sample) were compliant at T0, T1, T2 and T3.

Results of the survey

The data from the first section reveal that the volunteers of both groups, were majorities' males (63%) mostly over fifty years (58%), with an educational qualification correspon-

Table 2. Microbiological reference standards for the various foodstuffs submitted to microbiological investigation.

Category	Description	Bacteriological tests	Standard (CFU/g)°			
			Satisfying	Acceptable	Unsatisfying	Potentially damaging
A	Fully cooked food (*e.g.* pasta, vegetables)	Aerobic plate counts	$<10^5$	$10^5 \le x < 10^6$	$\ge 10^6$	
		Enterobacteriaceae	$<10^2$	$102 \le x < 10^4$	$\ge 10^4$	
		E. coli	<10	$10 \le x < 10^2$	$\ge 10^2$	
		Coagulase-positive staphylococci	$<10^2$	$10^2 \le x < 10^3$	$\ge 10^3$ $\ge 10^5$	
		Bacillus cereus	$<10^2$	$<10^2 \le x < 10^3$	$\ge 10^3$ $\ge 10^5$	
		Salmonella spp.	Absence in 25 g	Absence in 25 g	Absence in 25 g	Absence in 25 g
		L. monocytogenes	Absence in 25 g	Absence in 25 g	Absence in 25 g	Absence in 25 g
B	Multi-ingredients preparations, consisting of cooked and uncooked food ready for consumption (*e.g.* rice salads, mixed salads)	Aerobic plate counts	$<10^6$	$10^6 \le x < 10^7$	$\ge 10^7$	
		Enterobacteriaceae	$<10^3$	$10^3 \le x < 10^4$	$\ge 10^4$	
		E. coli	$<5x10^2$	$5x10^2 \le x \le 5x10^3$	$>x10^3$	
		Coagulase-positive staphylococci	$<10^2$	$10^2 \le x < 10^3$	$\ge 10^3 \ge 10^5$	
		Bacillus cereus	$<10^2$	$10^2 \le x < 10^3$	$\ge 10^3 \ge 10^5$	
		Salmonella spp.	Absence in 25 g	Absence in 25 g	Absence in 25 g	Absence in 25 g
		L. monocytogenes	Absence in 25 g	Absence in 25 g	Absence in 25 g	Absence in 25 g

CFU, colony forming unit; A, multi-ingredients preparation cooked ready-to-eat samples; B, multi-ingredients preparation ready-to-eat to be eaten uncooked or some raw ingredients samples. °Ce.I.R.S.A guidelines (http://www.ceirsa.org/pubblicazioni.php).

Table 3. Results of microbiological analyses.

Category	Parameters	Standard criteria	T0			T1				T2				T3			
		S	A	U	PD	S	A	U	PD	S	A	U	PD	S	A	U	PD
A	Aerobic plate counts	1,2,4	3,5			1,2,4	3,5			1,2,4	3,5			1,2,3,4			
	Enterobacteriaceae	1,2,4	3,5			1,2,4	3,5			1,2,4	3,5			1,2,3,4			
	E. coli	1,2,3,4	5			1,2,3,4	5			1,2,3,4	5			1,2,3,4,5			
	Coagulase-positive staphylococci	1,2,3,4	5			1,2,3,4	5			1,2,3,4	5			1,2,3,4,5			
	Bacillus cereus	1,2,3,4	5			1,2,3,4	5			1,2,3,4	5			1,2,3,4,5			
	Salmonella spp.	1,2,3,4,5				1,2,3,4,5				1,2,3,4,5				1,2,3,4,5			
	L. monocytogenes	1,2,3,4,5				1,2,3,4,5				1,2,3,4,5				1,2,3,4,5			
B	Aerobic plate counts	6,10,11	7,9	8		6,7,10,11	9	8		6,7,10,11	8,9			6,7,8,9,10,11			
	Enterobacteriaceae	11	6,7,8,9	10		6,11	9	7,8,10		6,9,11		7,8,10		6,8,9,11	7,10		
	E. coli	6,7,8,9,10,11				6,7,8,9,10,11				6,7,8,9,10,11				6,7,8,9, 10,11			
	Coagulase-positive staphylococci	6,7,8,9,11	10			6,7,8,9,11	10			6,7,8,9,11	10			6,7,8,9,10,11			
	Bacillus cereus	6,7,8,9,11		10		6,7,8,9,11		10		6,7,8,9,11		10		6,7,8,9,11		10	
	Salmonella spp.	6,7,8,10,11			9	6,7,8,10,11			9	6,7,8,10,11			9	6,7,8,9,10,11			
	L. monocytogenes	6,8,9,10,11			7	6,8,9,10,11			7	6,8,9,10,11			7	6,7,8,9,10,11			

A, multi-ingredients preparation cooked ready-to-eat samples; B, multi-ingredients preparation ready-to-eat to be eaten uncooked or some raw ingredients samples; 1, lasagna; 2, strudel with ham and cheese; 3, ravioli with meat; 4, potato dumplings; 5, omelette with vegetables; 6, rice salad; 7, wheat salad; 8, Greek salad; 9, roast beef; 10, cous cous with vegetables; 11, lemon mousse; S, satisfying; A, acceptable; U, Unsatisfying; PD, potentially damaging.

ding to high school (57%) and the majority area permanent volunteers (61%). The distribution of correct replies for the topics, between groups 1 and 2 is: knowledge on personal hygienic prerequisites (73 *vs* 81%), foodborne diseases (68 *vs* 79%), labeling (72 *vs* 45%), traceability (7 *vs* 31%) and good manufacturing practice (41 *vs* 57%), and in Figure 1 are showed the correct replies for every single question in CO's volunteers belonging to groups 1 and 2. In particular, the data were not statically compared, because the aim of the study was to describe in detail the current situation of the volunteer's knowledge on food safety and GMPs procedures.

Discussion

The results showed that the samples n°7 (wheat salad) and n°9 (roast beef) (18.8% of total food samples), with the presence of *Listeria monocytogenes* and *Salmonella* spp., represent a dangerous situation for public health and that the correct handling procedures are not well applied from catering operators or perhaps the entire flow is out of control (EFSA, 2014).

Also, the amounts of *Enterobacteriaceae* and *Bacillus cereus* in food sample n°10 (cous cous with vegetables) show a primary contamination in accordance to a process without use of high temperature (cooking), which represents an important risk situation. The low (cooling and freezing) storage temperatures did not have any positive influence to improve a food samples such as for sample n°10 (cous cous with vegetables). All the volunteers (groups 1 and 2) are engaged only in the food recovery phases, while no one is engaged in the cooking activity.The knowledge of volunteers is lacking – especially for group 1 – on the items about traceability and good manufacturing practices. The volunteers of groups 2 and 1 have an inadequate knowledge of GMPs, which shows the necessity of a further training course.

Conclusions

The mission of Food Bank is to recover much more food from donors to respond immediately to the nutritional requirements of the people in food poverty. The COs are very complex, so it is difficult to handle the recovery correctly. The COs flows are described in the Manual of good practices for Charitable organizations (Balzaretti *et al.*, 2016) validated by the Italian Ministry of Health in compliance with the Regulation (EC) 852/2004 (European Commission, 2004) and published on *Banco Alimentare* Foundation Onlus, *Caritas Italiana* and Italian Ministry of Health website. Food Bank in France established that the food surplus from catering stored at 63°C cannot be recovered by COs unless the temperature is not rapidly brought to 10°C, while *Caritas Italiana* and FBAO, in the Manual of good practices for COs, have established the correct recovery and reuse criteria of food from catering, canteen stored at ≥60°C.

The *second life* of surplus, especially if recovered from canteen and catering, is strictly related to the *first life* and the food business operators should evaluate if the food to donate is still in a good and sure state. Sometimes the ethical approach of food donors, COs and especially of occasional volunteers (no permanent volunteers), is related to the increasing necessity to donate food to needy people, and risks are not considered.

The inadequate knowledge of the volunteers on good manufacturing practices can lead to underestimate the risk in the food recovery chain. The authors underline that all volunteers before handling foods, should be trained from safety experts on food science arguments, good practices, *etc*., and should follow the specific regional and national laws on food safety.

On the other hand, the presence of contamination in samples 7, 9 and 10 at T0 shows the donors should consider the second life of donated food as a primary process and with a system configuration. First of all, the donors should apply the good hygienic practices to ensure a safety donation. To guarantee safety all over the food supply chain and people in need, the Food Banks should share with donors the complexity of their activities and together plan a safe *second life* of foods recovered.

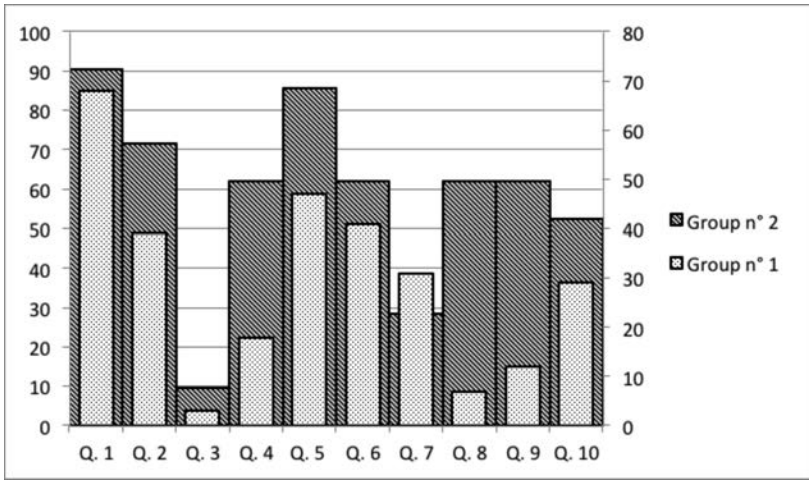

Figure 1. Distribution (%) of correct replies for each question.

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